VOL. V

U.S. DEPARTMENT OF THE INTERIOR

PROTOTYPE OIL SHALE LEASING PROGRAM

TRACT C-b

QUARTERLY REPORT #1

(Through November 30, 1974)

Submitted to:

Mr. Peter A. Rutledge
Area Oil Shale Supervisor
Conservation District
U. S. Geological Survey
Grand Junction, Colorado

By:

Ashland Oil, Inc.
Atlantic Richfield Company, Operator
Shell Oil Company
The Oil Shale Corporation

JANUARY 14, 1975

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CORE DRILLING AND ASSOCIATED
GROUND WATER (CONT'D)

Pursuant to Section 33 of Federal Lease C-20341, and section 231.5, Title 30, Part 231 of the Federal Code of Regulations the below described materials submitted by the lessee in accordance with an approved Exploration Plan has been deemed confidential and . . . .

FOR U.S. GOVERNMENT USE ONLY

Nature of material so classified: MAR. 31 1975

CORE ASSAY DATA: For determination of shale oil content

(This data may be examined upon written approval of the Area Oil Shale Supervisor or the lessee)

Core Assay Data

Assays of core samples are being run to determine certain parameters essential for both economic evaluation and mining information. Those parameters for which core samples are currently being analyzed include:

(1) shale oil content
(2) sodium
(3) alumina.

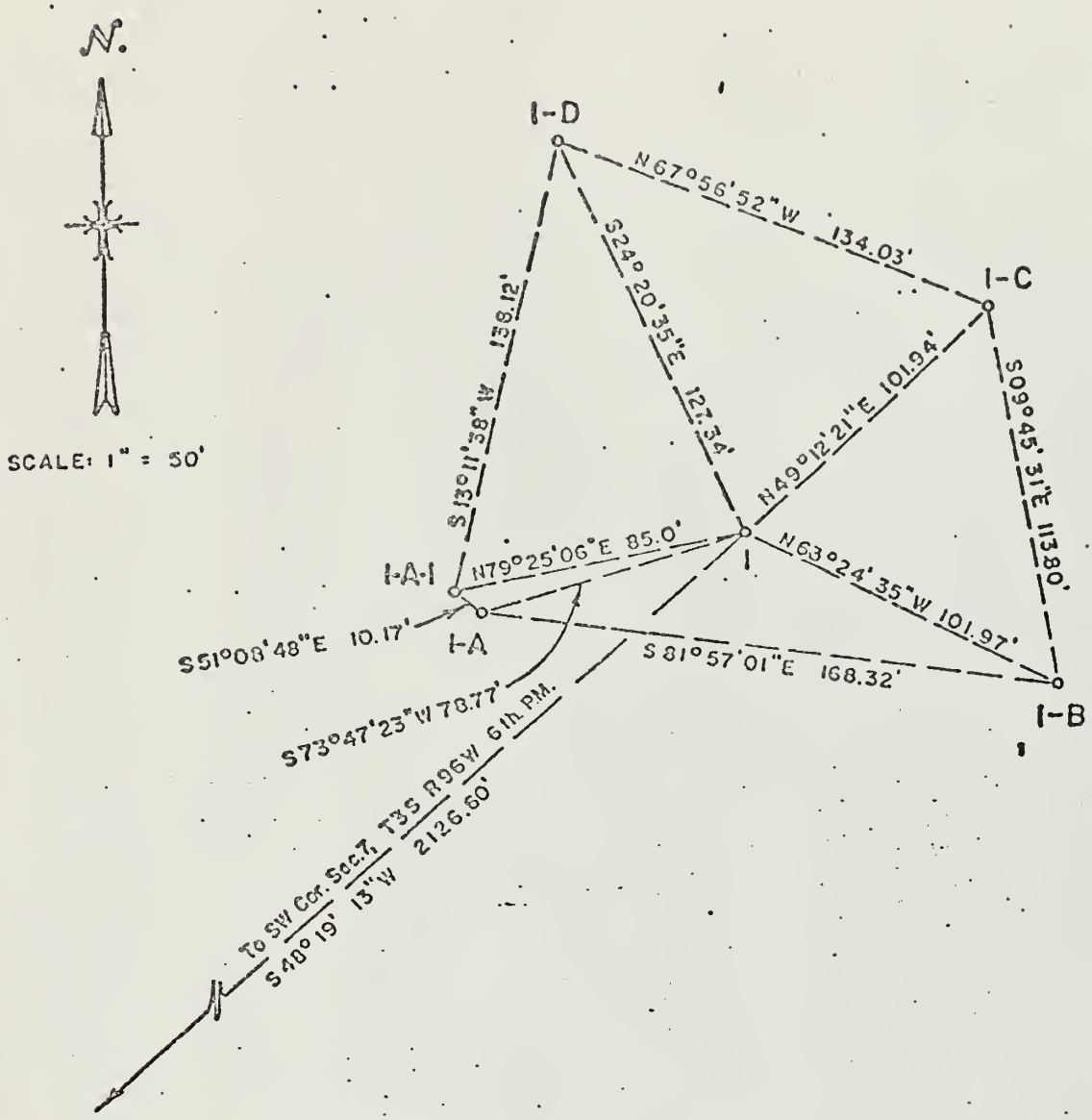
For the determination of shale oil content, cores are sampled on one-foot intervals and these samples are subjected to laboratory analysis for kerogen content. Each sample is retorted through a specified time curve to yield data on oil content in gallons per ton, water content in gallons per ton, and residue weight in pounds per ton. In addition, gas-plus-loss is calculated for each sample.

Analysis for sodium is made from ten-foot composite samples and for alumina on core samples taken from one-foot intervals. Sodium content is determined by leaching one gram of raw shale in water and measuring the dissolved sodium content by atomic absorption. Alumina is determined by leaching one gram of spent shale with 50 milligrams of 20-gram-per-liter sodium hydroxide solution and measuring the soluble alumina by atomic absorption. Alumina in spent shale is then corrected back to a raw shale basis using the Fisher assay weight loss.

The laboratory data sheets for those wells on which assays are complete are included in this section of the report. This information, however, is CONFIDENTIAL and is so marked.

Note

The above described material has been placed in a separate confidential file. Permission to review this file must be obtained from the AOSS.



NOTE: I, I-A, I-A-1, I-B are Drilled.
I-D in process of being Drilled.
I-C not Drilled.

Aquifer 1A Marker Bed Depths

Top of the "A" is 1307,
Mahogany marker, 1339.45.
Top of the "B" is 1480 ft.

WESTERN ENGINEERS INC.
CORE HOLE LOCATIONS
ATLANTIC RICHFIELD COMPANY
I, I-A, I-A-1, I-B, I-C, & I-D
RIO BLANCO COUNTY, COLORADO
SURVEYED CJB DRAWN GLA
GRAND JCT, COLO 8/2/74

GEOGRAPHIC LOCATION AND MARKER BIDS
OF SORGHUM GULCH CORE HOLE NO. 10

Location : NE NE NE Sec 13, T3S, R97W, 6th PM (97 ft FNL, 184 ft FEL), Rio Blanco County, Colorado

Elevation : 6950 ft G.L.

Total Depth: 2211 ft

Base "A" Groove	1315 ft
Mahogany Marker	1344 ft
Top "B" Groove	1491 ft
Blue Marker	2505 ft
Core Interval Assayed	1207-2211 ft

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Core and Cuttings Trace Element Analysis

CORE AND CUTTINGS TRACE ELEMENT ANALYSIS

The Conditions of Approval for the Core Drilling and Associated Ground Water Program require "sampling of drill cuttings or core with subsequent analysis to determine occurrence of arsenic, antimony, boron, cadmium, fluoride, mercury, and selenium" on all core holes until the Area Oil Shale Mining Supervisor has determined that additional sampling and analysis would yield redundant data.

Required laboratory analyses are in progress, and no laboratory analytical reports have yet been received by the Lessee. Therefore, these data will be accumulated for the second Quarterly Report.

Rock Mechanics

Pursuant to Section 33 of Federal Lease C-20341, and section 231.5, Title 30, Part 231 of the Federal Code of Regulations the below described materials submitted by the lessee in accordance with an approved Exploration Plan has been deemed confidential and . . . .

FOR U.S. GOVERNMENT USE ONLY

OTHER PARTIES W/ PERMISSION

Nature of material so classified: MAR. 31 1975

ROCK MECHANICS: Information essential to the structural design of an underground mine

This data may be examined upon written approval of the Area Oil Shale Supervisor or the lessee

ROCK MECHANICS

Rock mechanics test data provide information essential to the structural design of an underground mine. Currently, all geotechnical data collection and reduction is being performed by a mining consulting firm, Golder Associates, Inc. Data obtained by them or for them are analyzed and correlated for presentation in monthly progress reports. As of November 30, 1974, monthly progress reports had been received on only two holes, AT-1a and SG-10. Reports on other holes were awaiting receipt of assay information.

Since holes AT-1a and SG-10 were the first holes tested, much difficulty was encountered in both obtaining the necessary equipment and actually conducting the tests. Neither shear tests nor triaxial compression tests were run due to the unavailability of equipment. A standard triaxial chamber is being fabricated to accommodate our 3½ inch diameter core, and selected core samples are being saved from currently drilling holes to be triaxially tested when the chamber is available.

The following report from the consulting firm, Golder Associates, Inc., presents the rock mechanics data in detail.

Note

Material in this section is deemed sensative. while not presently classified as Confidential by the U.S. Government, it has been filed separately pending outcome of negotiations between the Boss and the lessee.


Golder Associates
consulting geotechnical engineers

Golder Associates
CONSULTING GEOTECHNICAL ENGINEERS

ADDENDUM TO JULY MONTHLY REPORT
GEOTECHNICAL STUDY
C-b OIL SHALE TRACT
COLONY DEVELOPMENT OPERATION
GRAND VALLEY, COLORADO, U.S.A.

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July 1974

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GOLDER, BRAWNER & ASSOCIATES LTD., 224 WEST 8th AVE., VANCOUVER, B.C., V5Y 1N5 CANADA • PHONE: (604) 879-9266 • TELEX: 04-508800

SUMMARY OF TEST RESULTS ON AQUIFER TEST 1A AND SORGHUM GULCH HOLE 10 C-b TRACT COLORADO, U.S.A.

1. INTRODUCTION

This report summarizes laboratory tests conducted by Golder Associates between June 24 and July 2, 1974 on the two cored holes, Aquifer Test Hole 1A and Sorghum Gulch Hole 10. These tests were performed in the field laboratory provided by Golder Associates on location at the C-b Tract, Colorado.

The tests were performed under adverse conditions resulting from the initial laboratory set-up and were conducted with the partial aim of debugging the system. A system and procedure have now been established with the laboratory set-up completed (in temporary tents); hence future core will be tested in a routine manner.

One particular reason for presenting the results of these two holes is so that we can evaluate the usefulness of the point load test. Two other tests, Brazilian test and Schmidt hammer rebound test have also been evaluated. The aim of these tests is to be able to evaluate the oil shale strength with a simple, quick, inexpensive test. If such a test could be established then a minimum number of relatively expensive uniaxial compressive strength tests could be performed, with the cheaper test being performed extensively over the whole length of core.

2. TEST RESULTS

Sixteen tests were performed on core from Aquifer Test Hole 1A (ATIA) in the upper rich zone. Tests were generally 10 ft. apart, covering 50 ft. of the probable mine roof zone, the mine horizon (70 ft.) and 30 ft. of the probable mine floor. Sixteen tests were performed in Sorghum Gulch Hole 10 (SG10) in the lower rich oil zone with similar test location relative to the mine horizon for the ATIA hole.

The test results for the 16 tests on ATIA are shown in Figure 1 through 16 and similarly in Figures 17 through 32 for SG10. The format for this data presentation has been discussed previously as mentioned in the monthly report dated July 3, 1974. This format allows all the results of all possible tests on a section of core to be recorded on one sheet. Note that not all tests were conducted on these two holes; for example, the elastic modulus was not determined nor double shear tests performed.

Brazilian tests and Schmidt hammer rebound tests were performed on the Sorghum Gulch Hole 10. Point load tests were performed on both holes at points around the uniaxial compressive strength test section. The results of the point load test have been reduced using standard computer programs at Golder Brawner & Associates Ltd., in Vancouver, B.C. These results are tabulated in Appendix I, which also shows the recording sheets for the point load test.

3. DISCUSSION OF RESULTS

The results of the 32 test sections have been plotted in Figure 33 through 38 to show the correlation between:

1)	Uniaxial compressive strength (UCS)	and density
2)	Point load strength	and UCS
3)	Tensile strength (Brazilian)	and UCS
4)	Schmidt hammer rebound	and UCS
5)	Schmidt hammer rebound	and density
6)	Point load strength	and tensile strength (Brazilian)

General comments on each of these figures follows:

1) Correlation not as good as expected, (Fig. 33).

2) Correlation very poor, (Fig. 34).

3) Correlation quite good, (Fig. 35). Although the tensile and compressive strength are regarded as independent material properties, for the range of oil shale grades tested, the ratio between the two appears relatively consistent. Note that all tests were performed on high grade oil shale (probably mine horizons).

4) Correlation appears quite good, (Fig. 36).

5) Correlation appears quite good, (Fig. 37).

6) Correlation poor, (Fig. 38).

These (preliminary and incomplete) results indicate that the point load strength correlates with neither the UCS nor the tensile strength, and hence no useful information can be gained from this test.

Both the Brazilian test and the Schmidt hammer rebound test appear promising, and hence should be continued.

As the range of oil shale grade tested was limited (high grade), the correlation between the Brazilian and Schmidt hammer tests and the UCS should be explored in lower grade oil shales. If this correlation holds over the complete range of oil shale grade, then 1) these simpler tests could be performed over the complete length of hole, and 2) the UCS tests performed only in the mine horizon and possibly at larger intervals than the 10 ft. currently used.

Yours very truly,

GOLDER ASSOCIATES

M. P. Hardy

J. F. T. Agapito, P.E.

MPH/mm

V74080

Gas Determination And Analysis

The Conditions of Approval for the Core Drilling and Associated Ground Water Program state:

> At least two gas samples must be obtained from each drill hole which penetrates the Mahogany and/or R-4 zones. Each sample will be analyzed for methane (CH_4).

It was our initial intention to obtain continuous gas sampling on every hole with a Baroid Gas Chromatograph. However, on our first hole, SG-10, we experienced severe instrument problems that resulted in complete failure of gas sampling for that hole (no data). Because of this experience, the Baroid continuous analyzer was supplemented on all succeeding holes with periodic "grab" samples collected in stainless steel cylindrical bombs which were sent to the lab for analysis.

Because of the close proximity of the cluster of wells on our Aquifer Test Pad, one "representative" well (AT-1c) was selected and gas sampling was done on that well only. All of the coreholes were gas sampled (with the exception of SG-10 as noted above), but none of the shallow alluvial wells were gas sampled since they did not penetrate the Mahogany or R-4 zones.

The following tables list the results of lab analysis of the cylindrical bomb grab samples, and the copies of strip charts show the results from the Baroid continuous analyzer. Caution: these data should be used in a QUALITATIVE sense only. We feel that the numbers reported here are meaningless in a QUANTITATIVE sense; they do not tell us (1) how much gas was coming up the hole (we have only the composition of a small split of the total gas volume which was comprised of down-hole gas mixed with an uncertain amount of circulating drilling air), (2) at exactly what depth down the long open hole during drilling any gas was being released (this is important since only gas near the relatively thin mining zone is of practical consequence), or (3) how the gas is contained underground. With regard to this last point, the gas could be (A) in solution in the groundwater, (B) contained in open fractures and joints and trapped there by the groundwater, or (c) actually trapped in the rock pore spaces. In the event of "A" or "B" above, it is quite probable that a dewatering program could also degas the interval to be mined.

Through the use of down-hole packer tests and the use of a gas separator in our aquifer test we are mounting a more definitive program to get better quantitative measurements and conclusions with regard to underground gas.

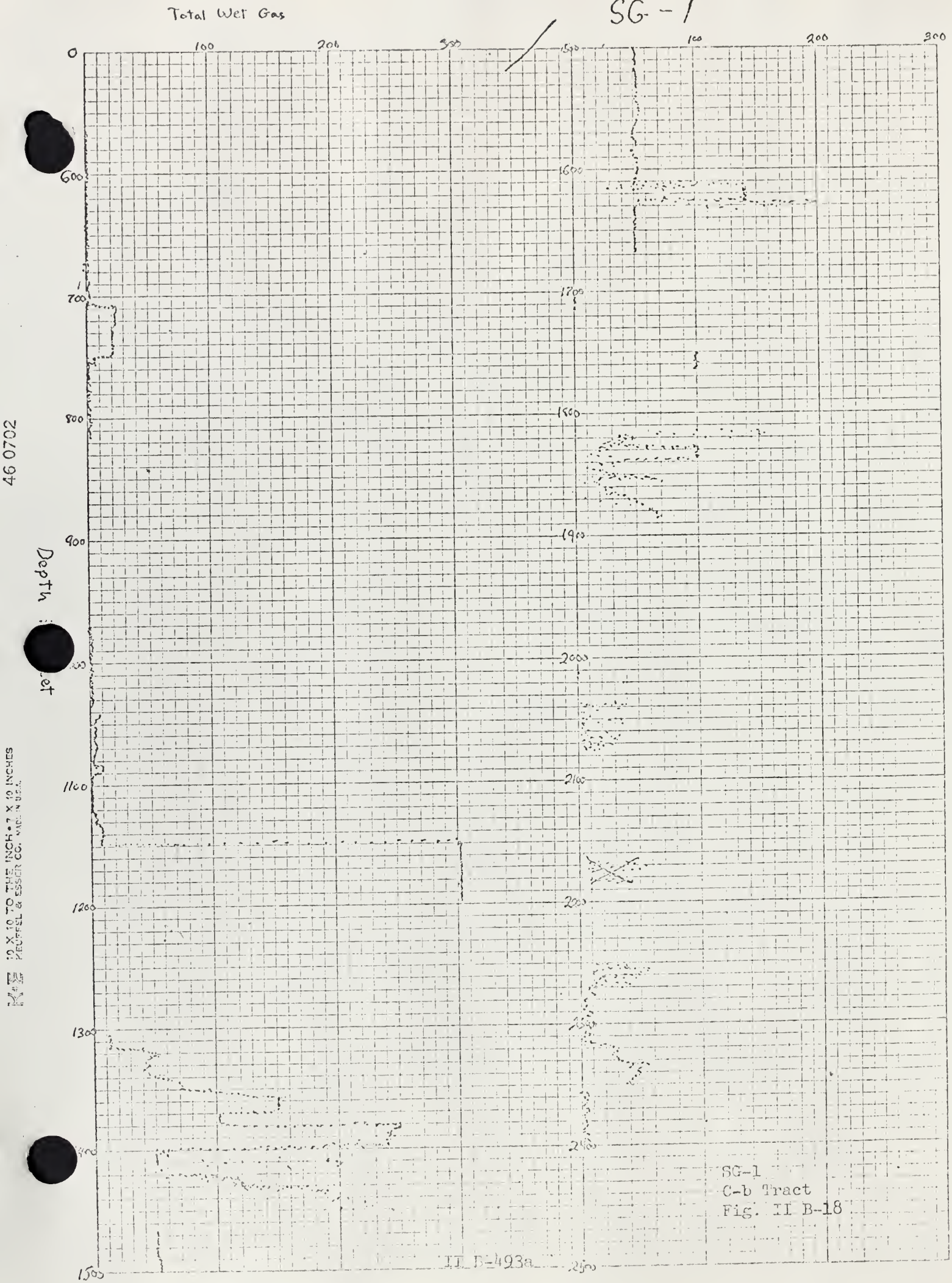
TABLE II B-17

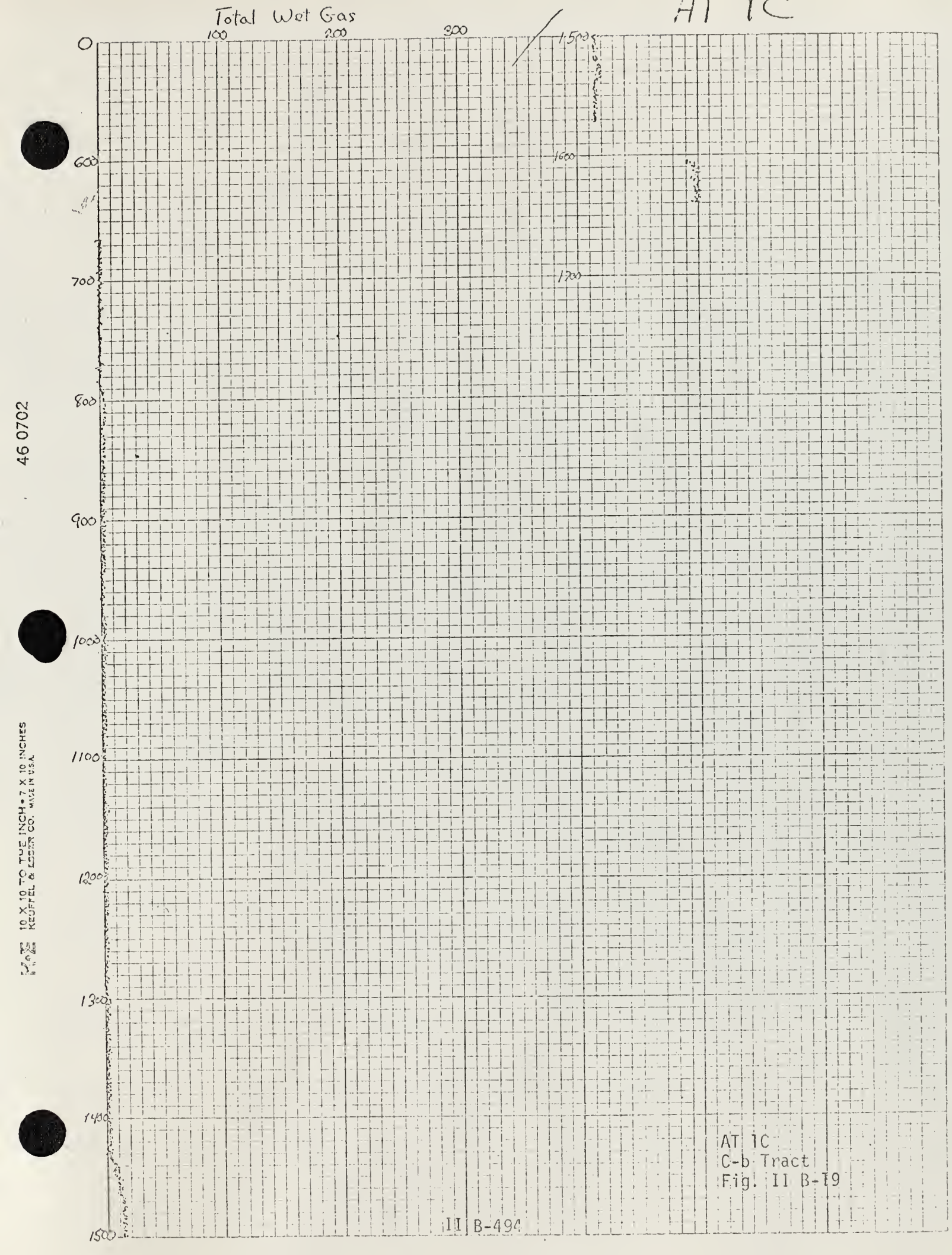
Analysis of Gas Samples From Tract C-b
Sorghum Gulch Core Holes
September - November 1974*

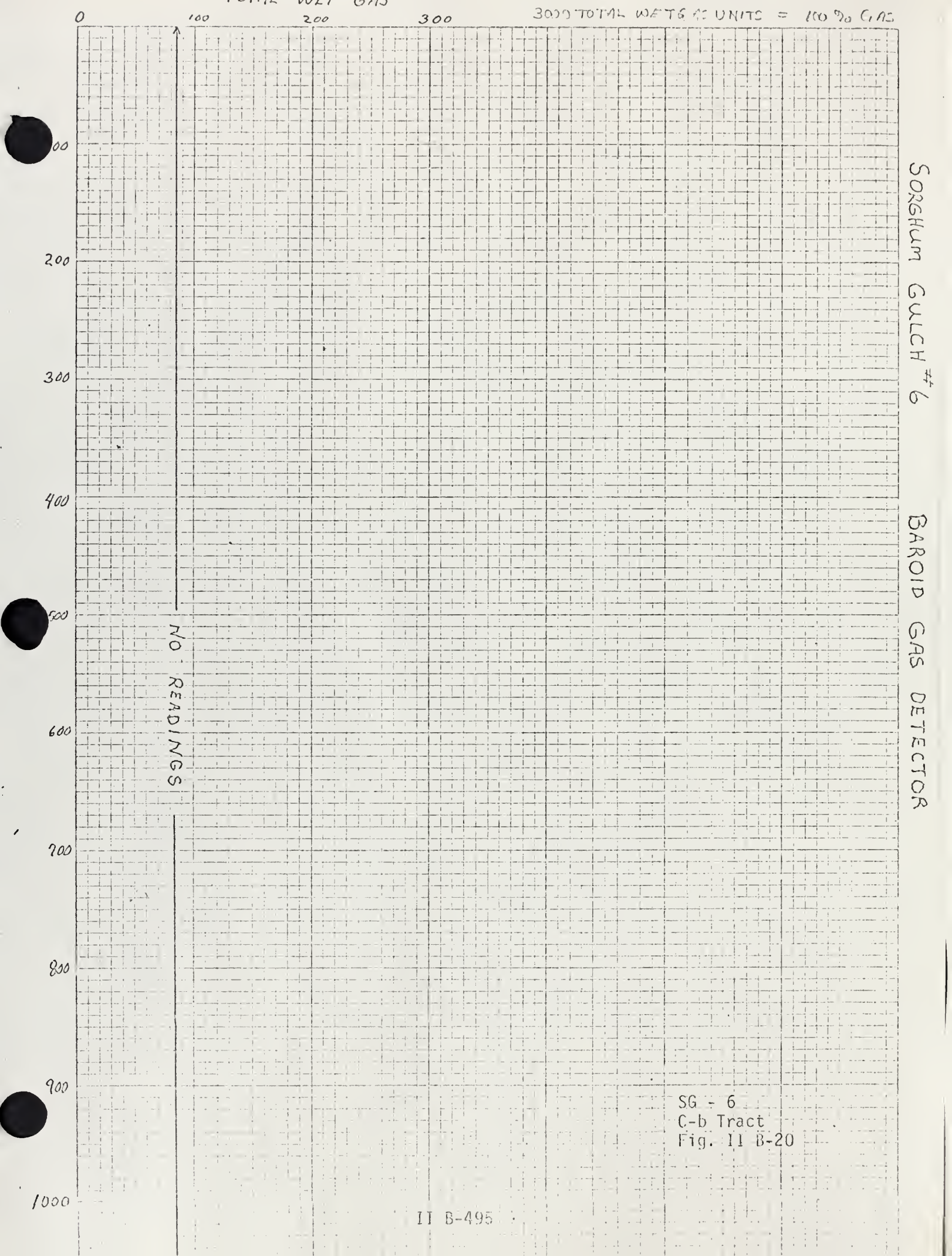
Core Hole	Description	Date (1974)	Depth (ft)	Methane** (mole %)	Ethane (Vppm)	Ethylene (Vppm)	Balance (air)
SG-1	----	----	613	0.11	----	----	Air
	Top Parachute Creek	----	706	0.38	----	----	Air
	20-feet below mine roof	11/12	1045	0.61	----	----	Air
	10-feet above base Mahogany zone	11/14	1095	0.49	----	----	Air
	10-feet below top of lower rich zone	----	1790	2.90	----	----	Air
	10-feet above lower rich zone	----	1830	3.49	----	----	Air
SG-6	----	8/9	1385	0.18	----	----	Air
	----	8/10	1415	1.0	----	----	Air
	----	8/20	2110	0.5	----	----	Air
	----	8/21	2140	0.05	23	----	Air
SG-8	50-feet above top of "A" groove	10/31	820	0.21	----	----	Air
	----	10/31	820	None	----	----	Air
	----	----	971	0.43	<1		Air
	Base mine Floor	----	1013	3.04	----	----	Air
	Near bottom of lower rich zone Core #78	11/17	1757	5.49	----	----	Air
	2600 mΩ bottom of Parachute Creek	----	2117	3.88	----	----	Air
SG-9	----	10/1	1200	0.0002	----	----	Air
	----	----	1295	0.0002	----	----	Air
	----	----	1350	0.11	----	----	Air
	----	10/11	1608	1.41	----	----	Air
	----	10/16	2073	1.62	2	----	Air
	----	10/19	2460	1.75	29	----	Air
SG-9	Run #42	----	2026	1.23	----	----	Air
	TD @ 2750-feet	----	2750	0.018	----	----	Air
SG-11	----	8/9	1353	(1)	(1)	----	Air
		8/10	1385	0.26	----	----	Air
	----	8/21	2048	1.10	----	----	Air
	----	8/21	2085	1.50	46	----	Air
	----	8/22	2143	1.20	35	----	Air
	----	9/1	2820	1.79	----	----	Air
SG-17	DST 780-800 Jetting during test	11/9	780-800	0.0009	----	----	Air
	Top Parachute Creek	11/10	859	0.0031	----	----	Air
	DST #3	11/11	822-869	0.0097	----	----	Air
	DST #4	11/13	866-919	0.0044	----	----	Air
	DST #5	11/14	919-970	None	----	----	Air
	DST #6	11/16	970-1017	0.0405	<1	----	Air
	DST #7	11/18	1017-1067	0.0371	----	----	Air
	DST #8	11/19	1066-1116?	0.0403	----	----	Air
	DST #9	----	1115-1166	None	----	----	Air
SG-18	----	10/3	1380	0.03	----	----	Air
SG-18-A	----	10/18	1330	0.18	----	----	Air
SG-19	----	9/22	860	1.82	----	----	Air
	----	9/23	930	9.15	2	<2(trace)	Air
	----	9/25	945	4.36	< 2	<2(trace)	Air
	----	9/27	981	0.96	----	----	Air
AT-1c	----	8/16	1365	0.16	----	----	Air
	----	8/16	1420	0.17	----	----	Air
Cb-2B	----	8/29	1220	0.07	----	----	Air
	----	----	not given	----	----	----	Air
No hole number given	19.4 ft. below the mining zone	10/5	1425.6	0.045	----	----	Air

* No H_2, CO, CO_2, or H_2S was found in any of the samples.
** Caution: data should be treated as QUALITATIVE only (see discussion).
(1) No sample available.

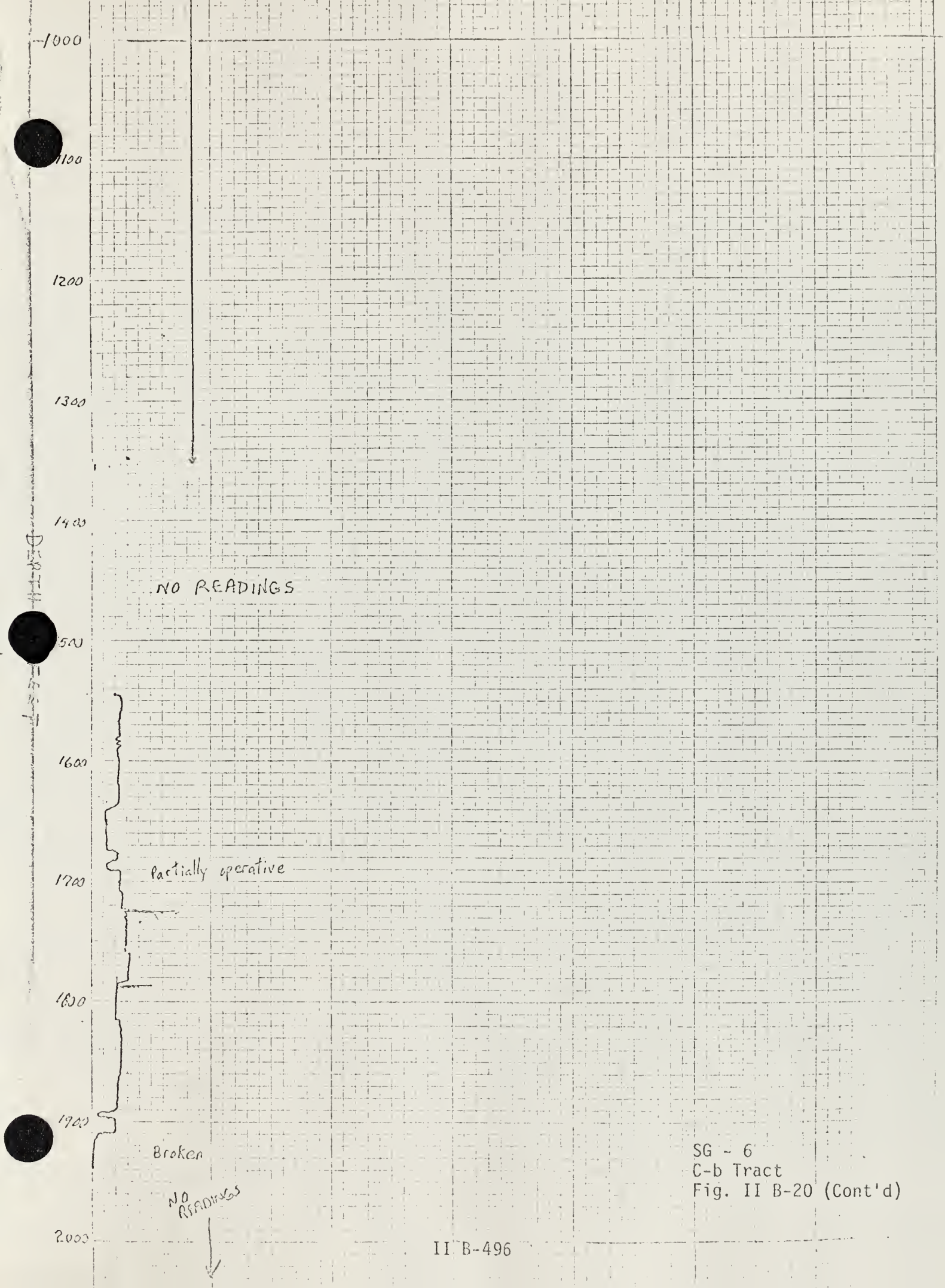
An explanation of the Baroid Gas Plots submitted with this report is probably in order. The plot is based on a combination of a Baroid Gas Detector strip chart and a geolograph strip chart, which are both time-based plots. The baroid Gas Detector strip chart is a plot of hydrocarbon concentration in the well discharge line versus time. The geolograph strip chart is a plot of drilling depth by feet, each foot indicated by a "kick" on the chart versus time. Since a large amount of drilling time is spent "tripping" (setting pipe up and down the core hole), water testing, and lost time, large quantities of strip chart paper is generated from both instruments which is not meaningful. Therefore, we have plotted the gas concentration versus depth, and that plot is submitted with this report as the most meaningful plot. The original Baroid Gas Concentration Plot and geolograph plots are available from our field geologist's files.


Total Wet Gas
SG-1
Depth
Feet
46 0702
SG-1
C-b Tract
Fig. II B-18

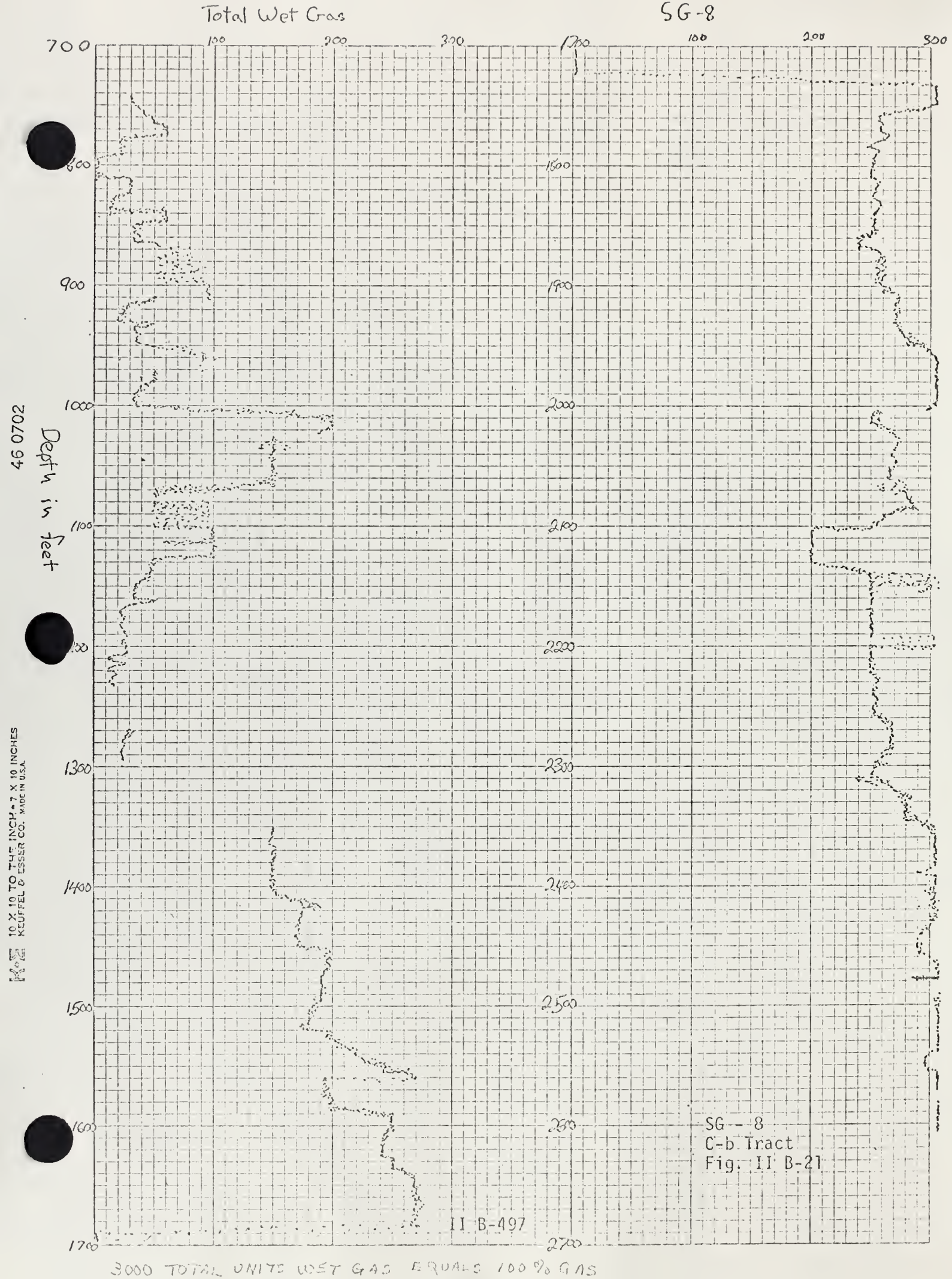


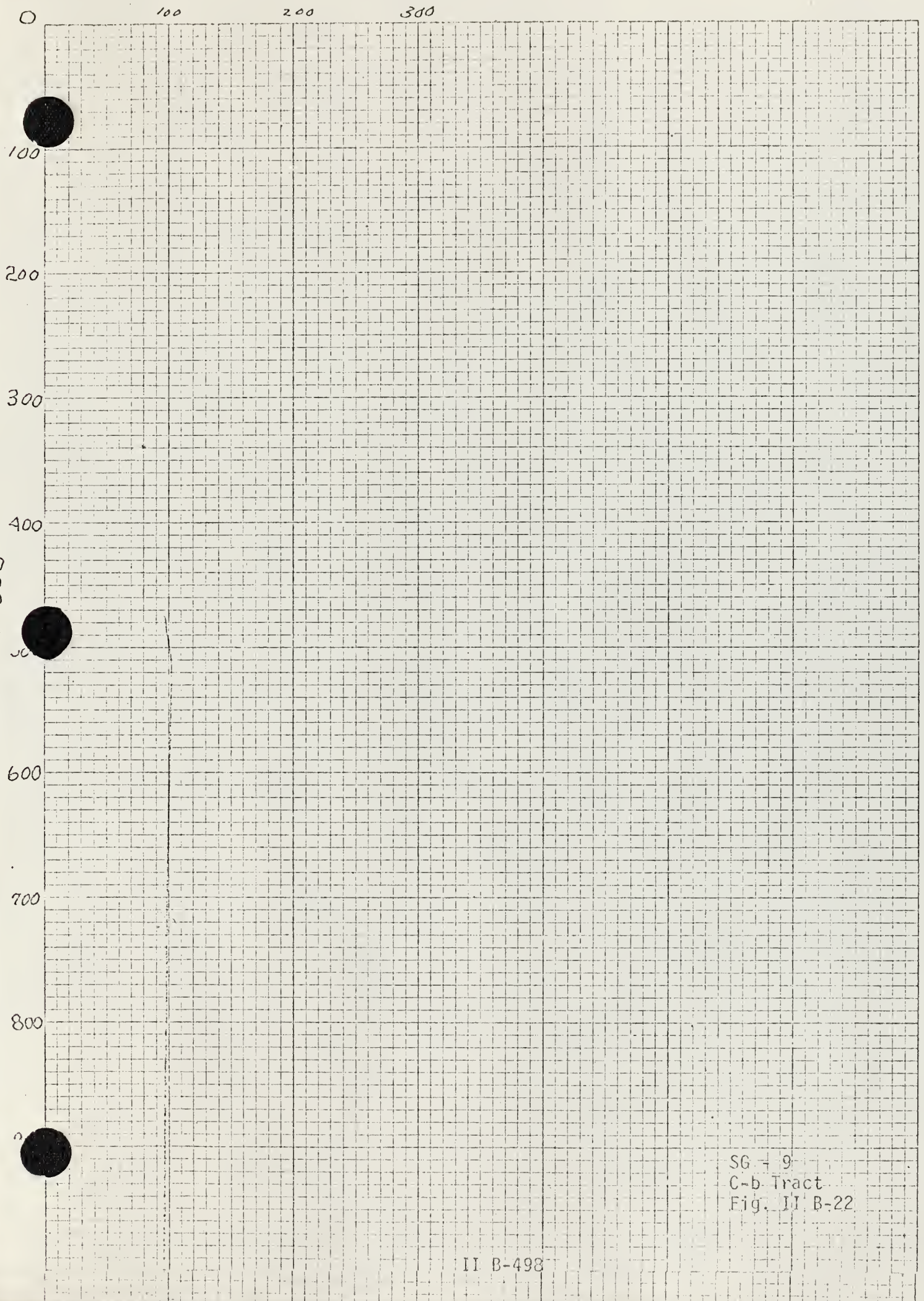


SG - 6
C-b Tract
Fig. II B-20

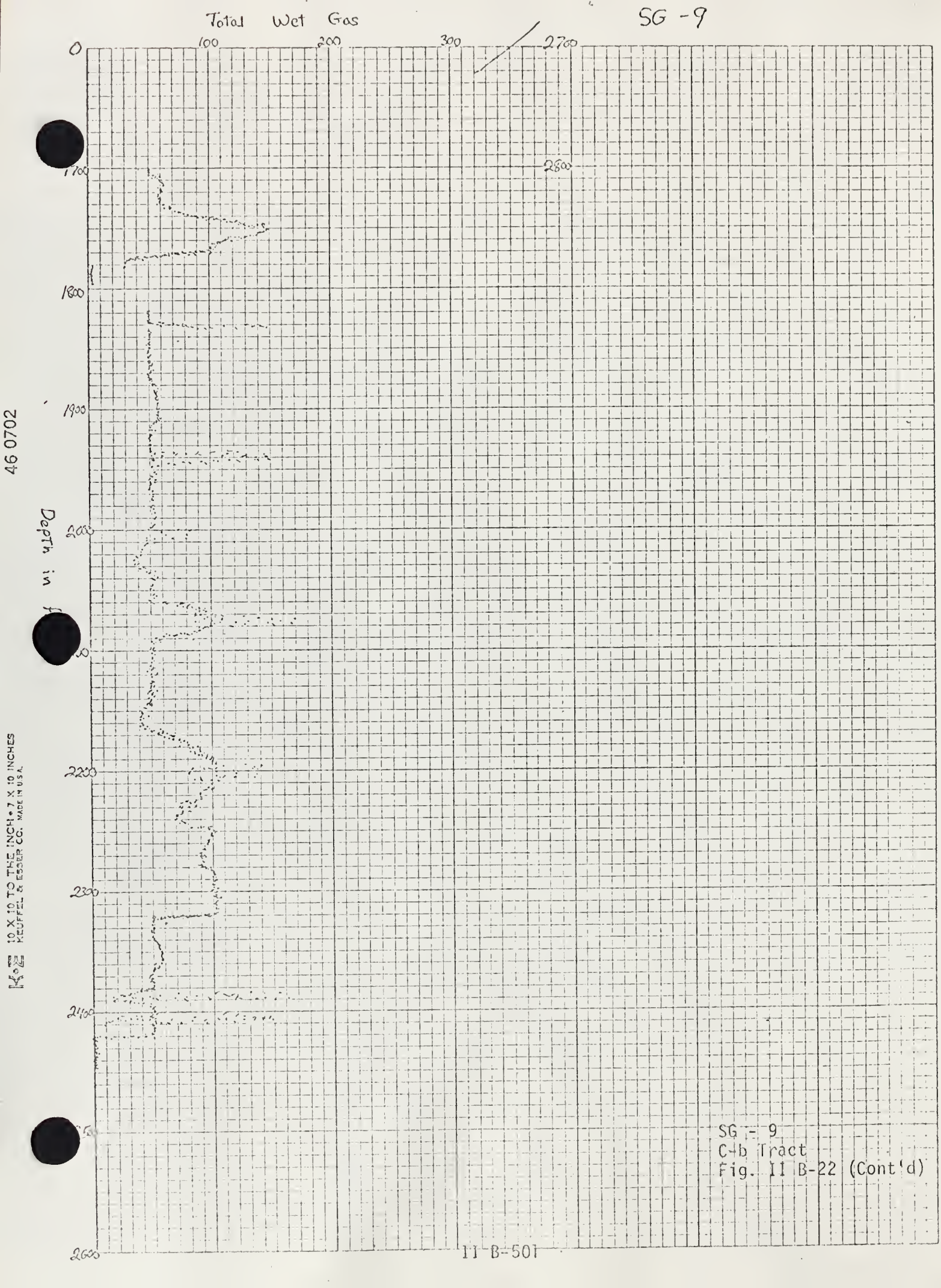


SG - 6
C-b Tract
Fig. II B-20 (Cont'd)

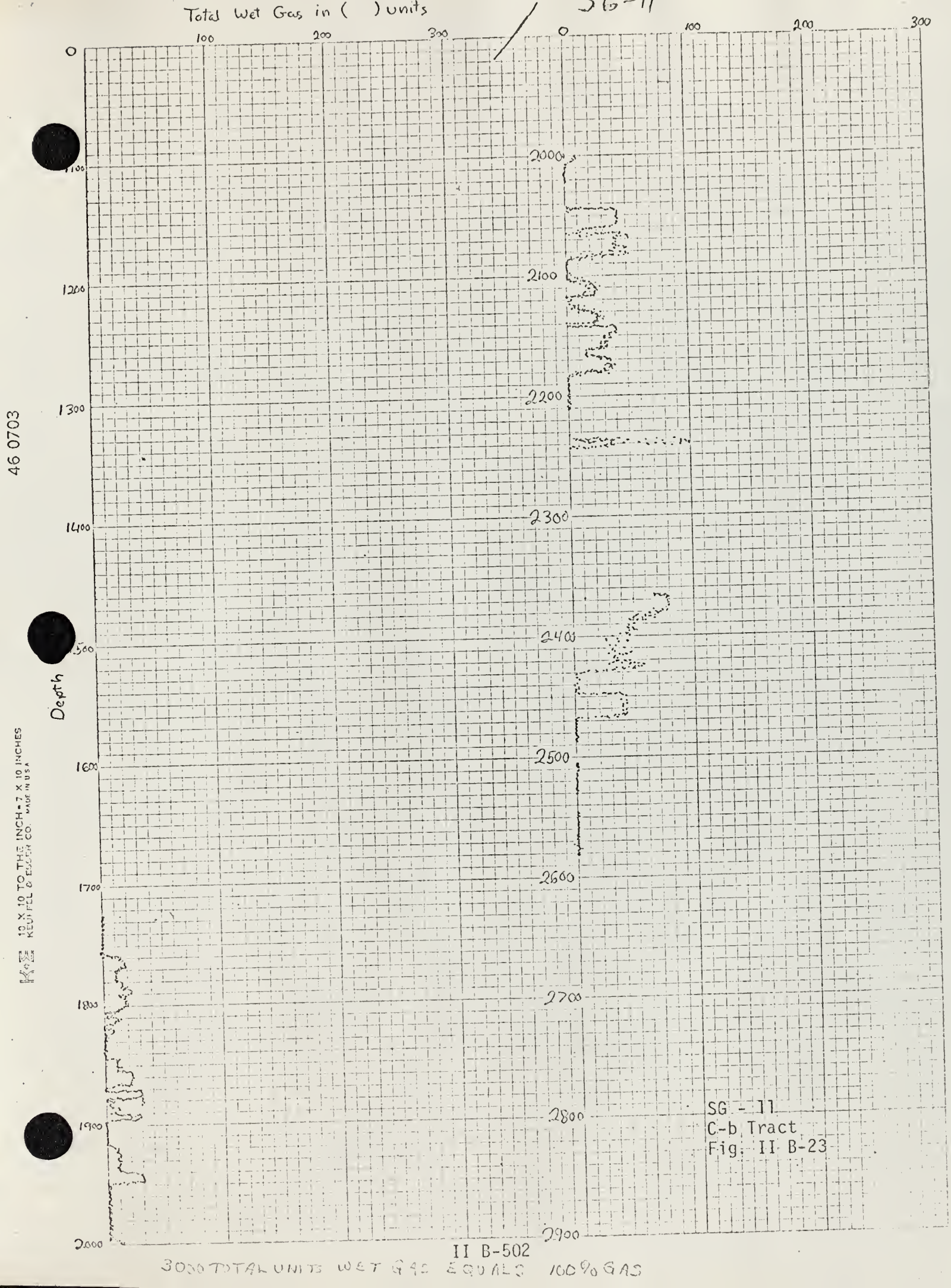

Total Wet Gas
SG-8
700
100
200
300
1700
100
200
800
1600
900
1900
1000
2000
2100
1100
2200
1300
2300
1400
2400
1500
2500
1600
2600
1700
2700
Depth in feet
46 0702
10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
SG--8
C-b Tract
Fig. II B-21
II B-497
3000 TOTAL UNITS WET GAS EQUALS 100% GAS



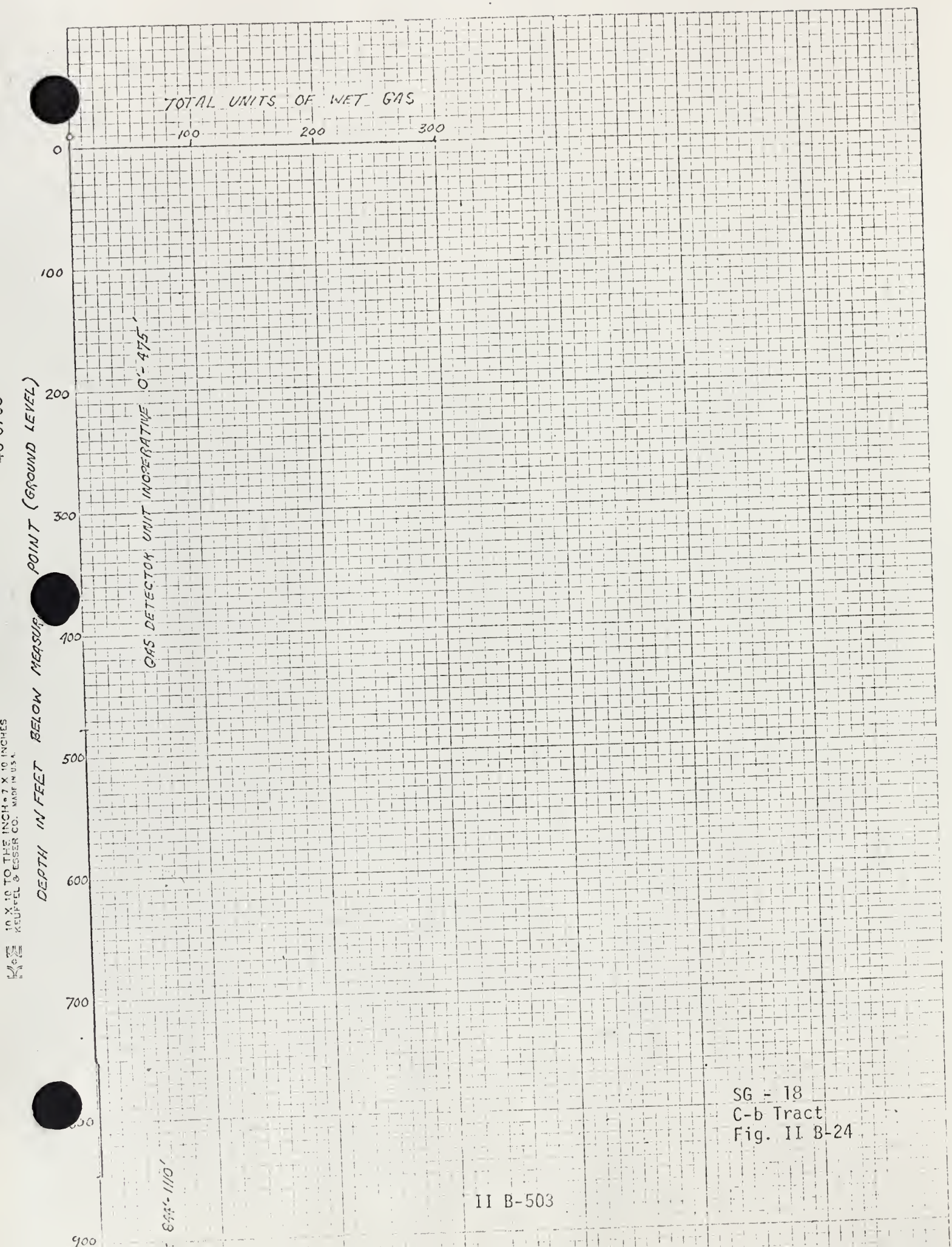
46 0703



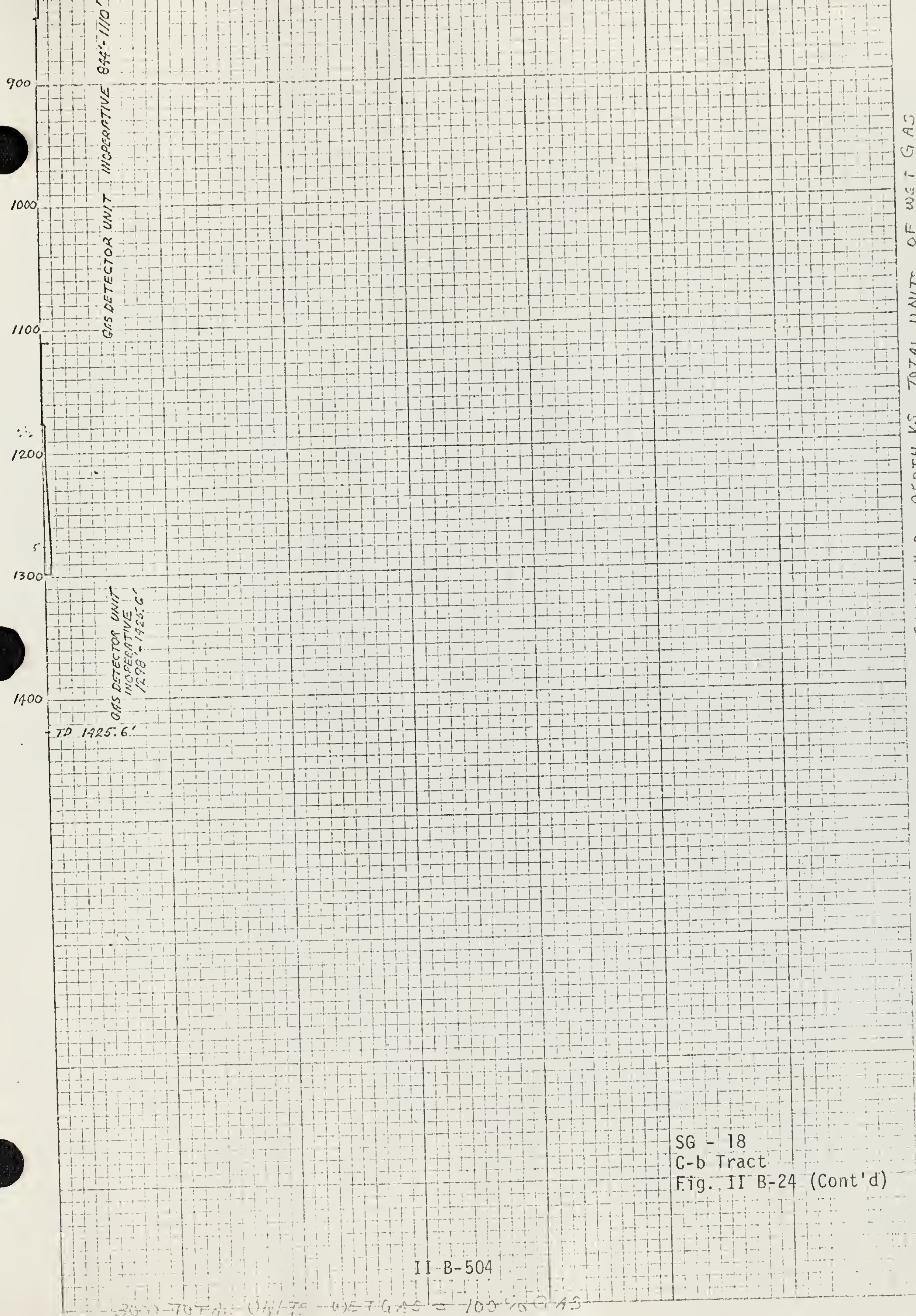
SG - 9
C-b Tract
Fig. II B-22 (Cont'd)


Total Wet Gas in ( ) units
100
200
300
0
100
200
300
0
100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
Depth
46 0703
10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
SG - II
C-b Tract
Fig. II B-23
II B-502
3000 TOTAL UNITS WET GAS EQUALS 100% GAS

ARCO ET AL; SORGHUM GULCH #18: DEPTH VS TOTAL UNITS OF WET GAS

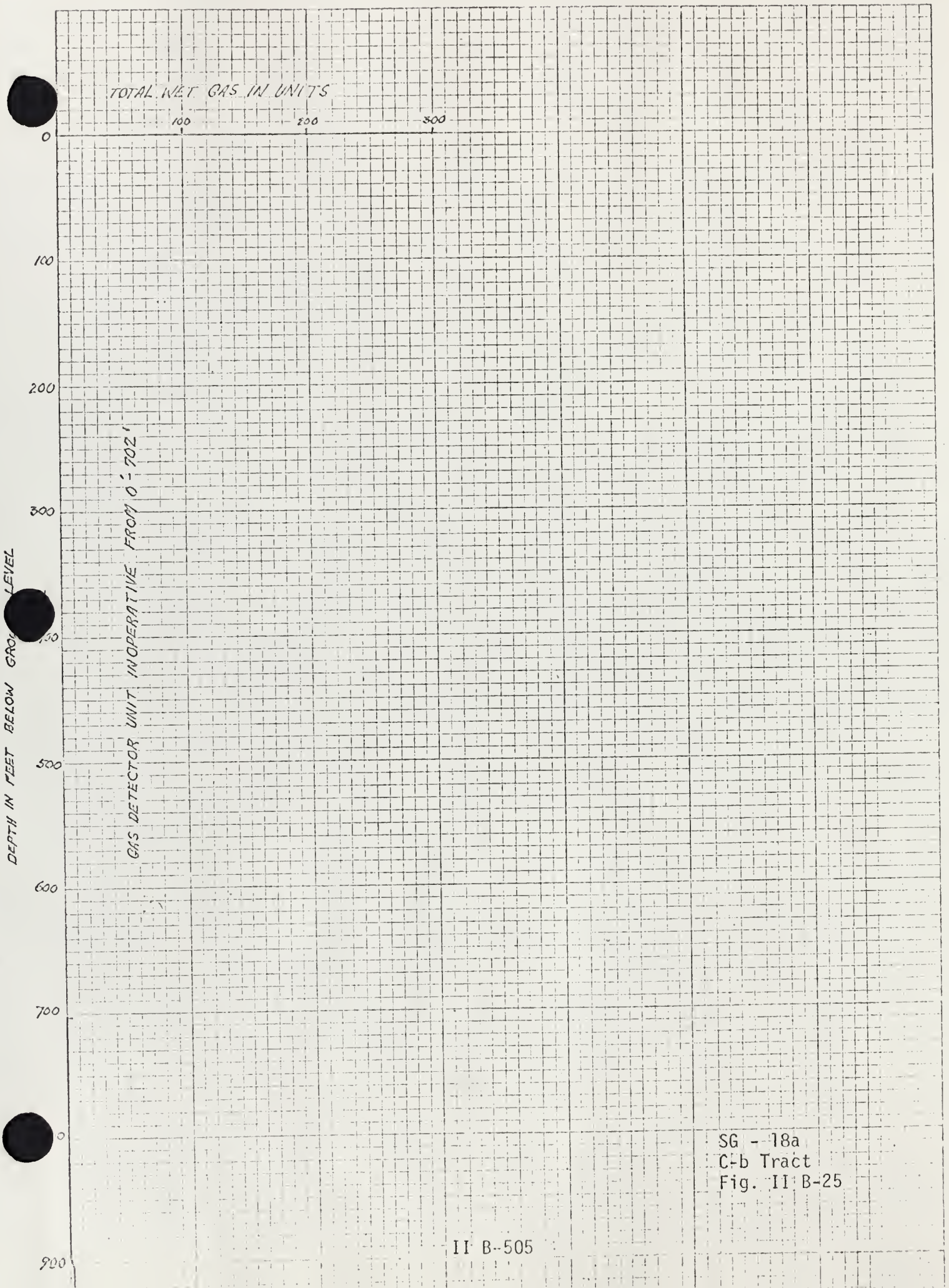


SG - 18
C-b Tract
Fig. II B-24

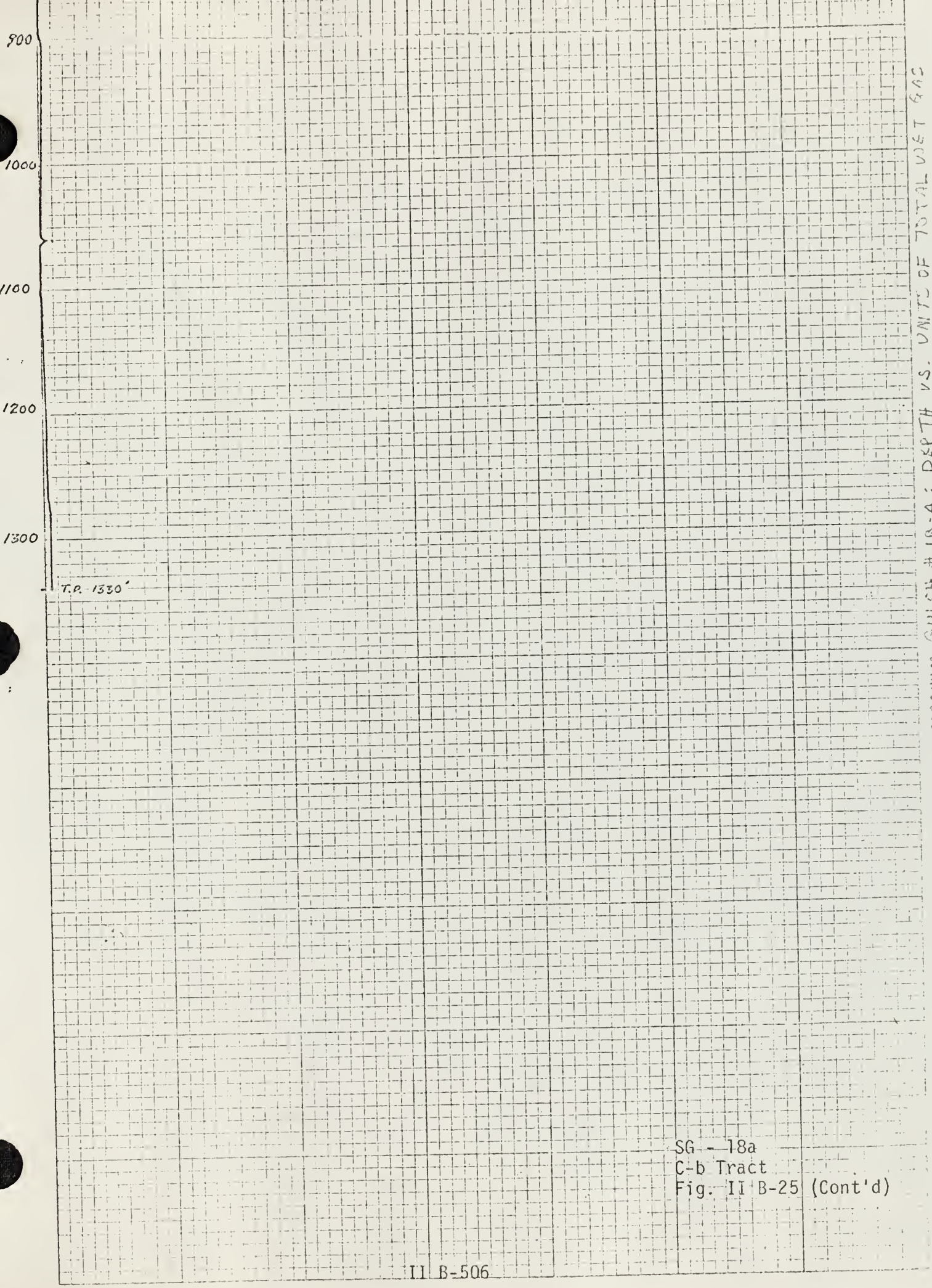


SG - 18
C-b Tract
Fig. II B-24 (Cont'd)

ARCO ET AL; SORGHUM GULCH #18-A: DEPTH VS. UNITS OF TOTAL WET GAS

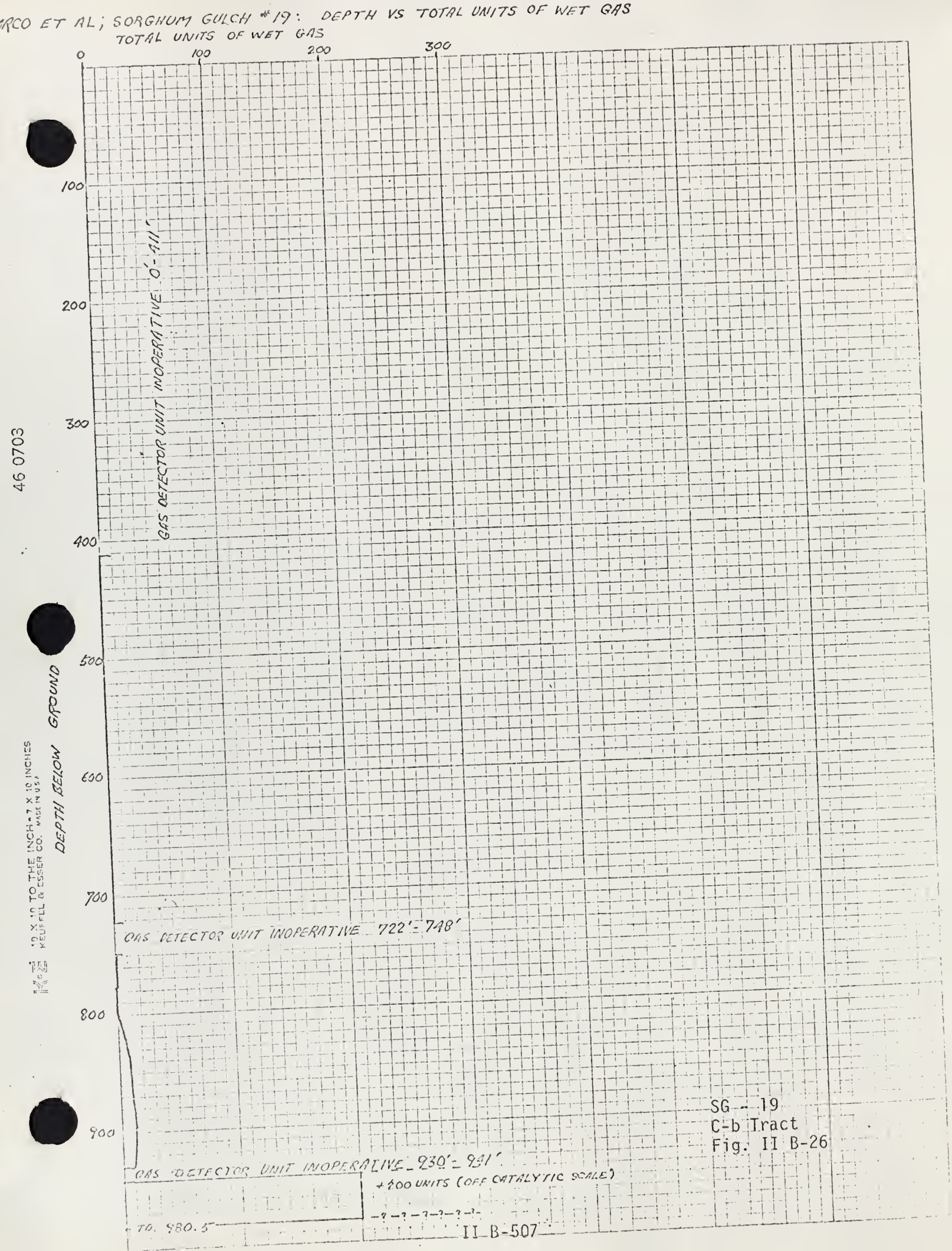


SG - 18a
C-b Tract
Fig. II B-25

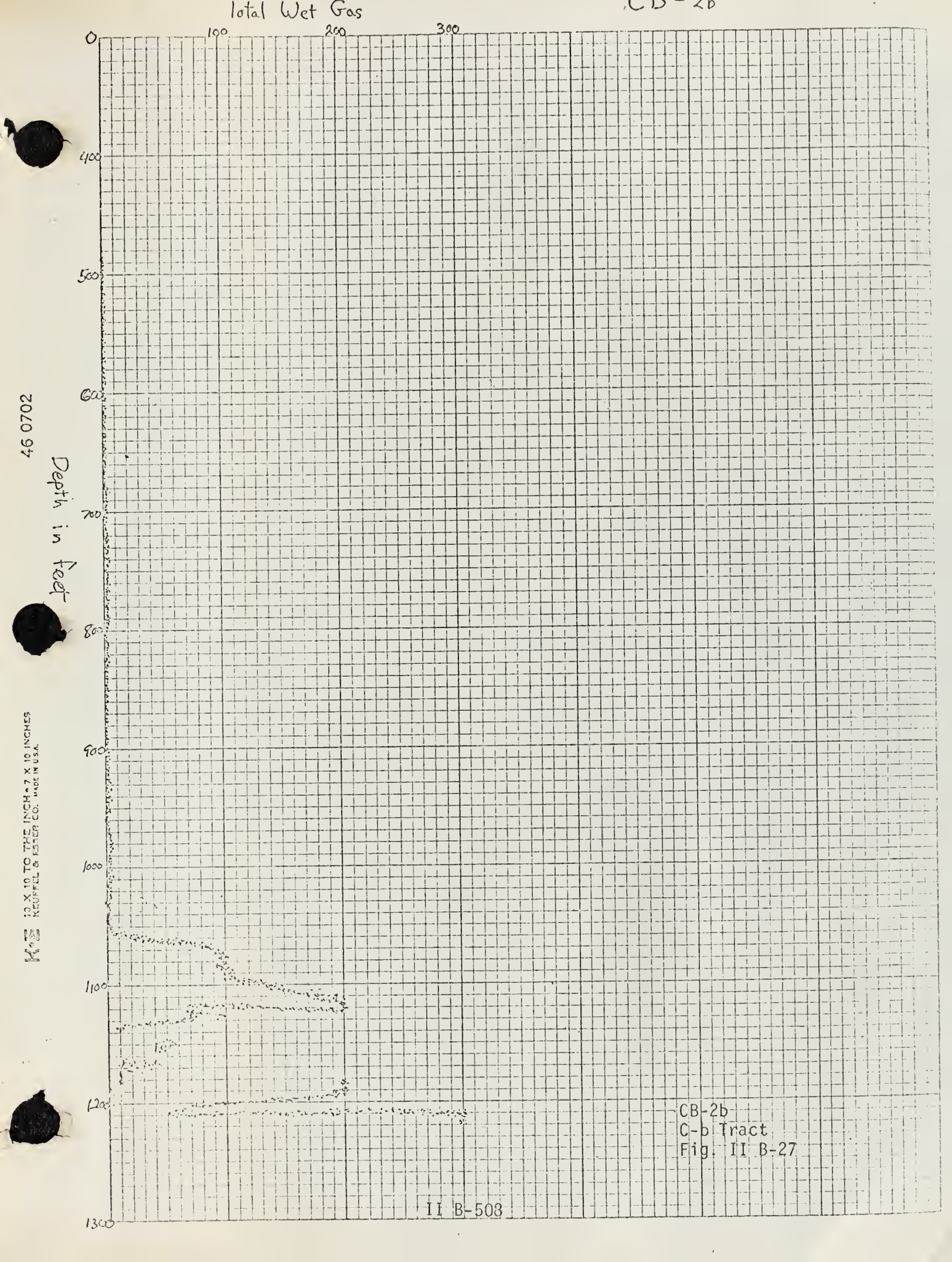


SG - 18a
C-b Tract
Fig. II B-25 (Cont'd)

ARCO ET AL; SORGHUM GULCH #19: DEPTH VS TOTAL UNITS OF WET GAS



SG - 19
C-b Tract
Fig. II B-26


Total Wet Gas
CB-2b
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
Depth in feet
46 0702
KEUFFEL & ESSER CO. MADE IN U.S.A.
10 X 10 TO THE INCH • 7 X 10 INCHES
CB-2b
C-b Tract
Fig. II B-27